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REPRODUCTIVE PERFORMANCE OF BREEDER SNAILS *Archachatina marginata* FED SOYA BEAN MEAL AT VARYING LEVELS OF INCLUSION

Eze, J. N. and Ahmed, M. A

Department of Agricultural Education,
Federal College of Education (Technical), Asaba, Delta State.
Corresponding Author: joantreasure45@gmail.com

Abstract
This study assessed the reproductive performance of breeders snails fed with soya bean meal (SBM) at varying inclusion levels of 23%, 25% and 27%. Thirty six (36) breeder snails were used and randomly divided into the three treatments groups of twelve (12) snails each. Each treatment was replicated three times with four snails in each replicate. The snails were eight (8) months old and they were reared for 10 weeks. The growth variables examined were growth performance, feed intake, feed conversion ratio and the reproductive characteristics. The data collected were subjected to one-way analysis of variance in a completely randomized design. Significant differences among means were separated using Duncan Multiple Ranged Test at 5% level of probability. Findings revealed that snails fed 27% of SBM supported higher final body weight of 110.75± 0.65 and body weight gain of 11.82± 0.66. Snails fed 23% SBM had lower Total feed Intake (488.87 ± 7.26) and highest feed conversion ratio (57.04± 3.45). The results on Initial shell circumference, shell circumference gain, Initial shell Length, Final shell Length and Shell Length gain were not significantly different. The results also revealed a significant difference in Number of eggs laid (23.67 ± 1.44), Percentage fertility (85.53 ± 1.83), Percentage Hatchability (91.02 ± 0.39) and the lowest Percentage embryo mortality of 8.98 ± 0.27.

Key words: *Reproductive performance, Breeder snail, Soya bean meal..*

Introduction
Snails are cold blooded animals and are also referred to as mini-livestock. Snails are soft bodied, consisting of shell and body when the animal is moving. Mini-livestocks are good sources of the much needed animal protein in human diet (Markramer, 1972). Snails are invertebrate with outer shell that is known as exoskeleton. Snails are active at night and in the dark places, during the day snails spend most of the day time under stones, soil of litter or decaying organic matter (Ajayi, *et al*., 1978, Ademolu, *et al.*, 2006).

Snail meat compares favourably with other conventional sources of animal protein like beef, pork and poultry meat (Nyameasem and Borketey-la, 2014). It has a crude protein of about 19% (Fagbuaro *et al*, 2006). The low cholesterol and high iron content of the meat makes it a good antidote for fat related diseases (Bright, 1996). Snail meat is palatable, nutritious and rich in essential amino acids such as lysine, leucine, isoleucine and pheylalamine as well as high iron content (Imvborie 1990 and Ebenebe, 2000). In traditional African medicine, snail meat is used in the preparation of concoctions for various cases such as reduction of labour pains and blood loss in pregnant women during delivery (Akinnusi 1998 and Amusan & Omidiji, 1999, Omole *et al*, 2010). The visceral part of snail meat can be used in place of fishmeal, in the formulation of livestock feed. Snails are hermaphrodites but self-fertilization cannot take place because one of the snail has to assume the place of the male while the other a female. *Archachatina marginata* reaches sexual maturity between 7-11 months while in *Achatina achatina,* sexual maturity is reached between 9-10 months.

Mating starts as soon as rain begins and continues until the dry season in late October. Snails lay eggs just few days after they are mated which is laid in cluster inside the soil. The number of eggs laid per clutch range from 5-11egg in *Archatinatina marginata*. An adult snail can lay four to eight times in a season. Snails, like other animals, need the basic nutrients (energy, protein, fat, amino acids, vitamins and minerals for optimum function of metabolic chemical reaction involved in growth maintenance, shell formation, production and reproduction (Imevbore *et al.,* 1993). Snails can utilize a number of feeds for growth as well as the fact that they are vegetarians (FAO 1996, Phillips 1992). Snails requirement for calcium, phosphorous, potassium and magnesium are relatively high compared to other animals. These minerals determine the rate of shell secretion by the mantle and for the rapid development of shell (Imevbore and Ajayi 1993; Imevbore and Ademosun 1988).Vitamins cannot be synthesized by snails and therefore must be provided in the diets ((Imevbore and Ajayi 1993).

Materials and Method

Prior to the experiment, forty (40) breeder snails (*Archachatina marginatan)* of 8 months old were purchased from the Songhai farms, Amukpe, Sapele in Sapele Local Government Area of Delta State, Nigeria. They were quarantined for two (2) weeks at the commencement of the experiment. This was to allow them to acclimatize with the environment. They were housed in constructed wooden cages suitable for scale backyard snail production. They were fed with herbages (paw-paw leaves (*Carica papaya*) and water leaf (*Talinium triangulae*)). Clean water was sprinkled every morning and evening, water was also put in shallow flat plastic plate for the snails to have access to water all the time, left over feed and dropping were removed on a daily basis. The duration of the experiment was for 10 weeks.

Experimental Diets

Soya bean was purchased at the Asaba main market. The soya bean was sundried and the well dried seeds were toasted for 10 minutes for easy removal of the seed coat and to destroy the anti-nutritional factors in the seeds. The seeds were then milled into mash to form soya bean meal (SBM). The soya bean meal was mixed with other ingredients such as maize, blood meal, wheat bran, bone meal, vitamin premix at different levels of inclusion which are 23%, 25% and 27%

Table 1: Composition of the Soya Bean Meal (SBM) in the Varying Levels of Inclusion

Levels of Inclusion	23%	25%	27%
Ingredients			
Yellow maize (9%)	55.50	50.00	43.00
Blood meal (80%)	12.00	12.00	12.00
Wheat bran (!5%)	16.00	16.00	16.00
Soya beans meal (44%)	12.50	18.00	25.00
Bone meal	3.00	3.00	3.00
Vitamin Premix	1.00	1.00	1.00
Total	**100.00**	**100.00**	**100.00**
	Calculated Analysis		
Energy (kcal/kg) (Metabolizable Energy)	2751.80	2685.80	2601.80
Crude Protein %	22.75	24.67	27.12
Calcium %	0.73	0.74	0.76
Crude Fiber %	4.05	4.33	4.70

Experimental Animals

A total of thirty-six breeder snails of the species *Archachatina marginata* were selected from the forty snails reared in the pre-experimental phase and were randomly divided into three groups of twelve snails each on the different inclusion levels of 23%, 25% and 27%. Each group was further randomized into three replicates comprising of four snails each. Each replicate was placed in three cages comprising of four snails.

Housing

The cages containing the experimental snails were constructed under a roofed shade to prevent direct sunlight on the snails. The cages used measured 51cm X 60cm X 30cm. In the cages, provision for feed was made with flat rubber plates, water was sprinkled on them twice daily, and water was also put in shallow flat plastic plates for the snails to have access to water all the time. The initial weights of the individual snail were taken and were randomly distributed into the cages to ensure similar average weight. The floors of the cages were filled with rich loamy soil to a depth of fifteen centimeters (15cm). The soil, before use, was exposed to sunlight to get rid of harmful soil micro-organisms. The snails retire to the soil provided after some active duty and they also lay their eggs in the soil.

Data Collection

Data were collected on growth performance, feed intake, feed conversion ratio and the reproductive performance by measuring the following variables.

Body Weight: Body weight was taken with a metallic electronic balance of 2 decimal places at the commencement of the experiment and on weekly basis thereafter, throughout the ten weeks of the experiment. This was done on replicate basis.

Shell Length: This was done by measuring the long axis of the snail on an individual basis with the aid of measuring tape and taken to the nearest millimeter.

Shell Circumference: This was done using a measuring tape around the largest circumference of the shell on individual basis. This was done fortnightly too.

Feed Intake: This was obtained weekly as difference in weight between the feed given and the left over for a week. A metallic electronic balance of 0.01-300g sensitivity was used.

Feed Conversion Ratio: This was calculated using the following formula

$$\frac{\textit{feed intake (g)}}{\textit{body weight gain (g)}} = \text{FCR}$$

Calculations were made on weekly basis and added up at the end of experiment which was the end of the 10^{th} week.

Reproductive Performance:

Fertility Percentage was calculated using the formula:

$$\frac{\textit{No. of fertile eggs}}{\textit{No. of eggs incubated}} \times 100$$

$$\text{Embryo mortality} = \frac{\text{No. of dead-in- shell}}{\text{Total No .of fertile eggs}} \times 100$$

Percentage hatchability was calculated using the formula:

$$\text{Embryo mortality} = \frac{\text{No. of eggs hatched}}{\text{Total No .of fertile eggs}} \times 100$$

Statistical Analysis

All data collected were subjected to one way Analysis of Variance in a completely randomized design and significant means were separated using Duncan Multiple Ranged Test at 5% level of probability using (SAS, 2011).

Results

Table 2 shows the results of the growth performance of the breeder snails fed with soya bean meal (SBM) at different levels of inclusion. The results revealed that there was no significant difference ($P>0.05$) in the initial body weight (IBW) of the breeder snail for the different level of inclusion. Significant differences ($P<0.05$) were observed in final body weight (FBW) with breeder snails fed with 27% SBM presenting highest final body weight of 110.75±0.65 and a highest body weight gain (BWG) of 11.82± 0.66. The initial shell circumference (ISC) were not significantly different ($P>0.05$). The final shell circumference were significantly different ($P<0.05$) About 17.01 ± 0.00 was obtained for the group fed with 27% SBM while17.02± 0.00 was obtained in the other groups of 23% and 25% of SBM inclusion. The results of table 2 also revealed that there was no significant difference ($P>0.05$) in the shell circumference gain with values range (0.95±0.00 - 0.96±0.00); initial shell length (9.01±0.00); final shell length (9.01±0.00 – 9.06±0.00) and shell length gain with value range of (0.05±0.00 – 0.06±0.00). The result show a significant different ($P<0.05$) in the total feed intake with snails in 27% level of inclusion group having the highest total feed intake of 519.78± 3.15 while the 23% and 25% level of SBM inclusion had 488.87± 7.26 and 504.53 ± 2.24 total feed intake respectively. The results of the feed conversion ratio (FCR) were also significantly different ($P<0.05$) among the three inclusion levels. However, the results of table 2 indicated that breeder snails in 27% SBM inclusion level showed the lowest FCR of 43.97± 2.33 compared with 23% and 25% SBM inclusion levels with 57.04± 3.45 and 50.76± 3.25 respectively.

Table 2: Growth Performance of the Breeder Snails fed Soya bean meal at varying levels of inclusion 23%, 25% and 27% for 10 weeks

Parameters	Levels of inclusion		
	23%	25%	27%
Initial Body weight (g)	98.93± 0.00[a]	98.93± 0.00[a]	98.93 ± 0.00[a]
Final Body weight (g)	107.50± 0.56[c]	108.87± 0.65[b]	110.75± 0.65[a]
Body weight gain (g)	8.57± 0.56[c]	9.94 ± 0.64[b]	11.82± 0.66[a]
Initial shell circumference (cm)	16.06 ± 0.00[a]	16.06 ± 0.00[a]	16.06 ± 0.00[a]
Final shell circumference (cm)	17.02± 0.00[a]	17.02± 0.00[a]	7.01 ± 0.00[b]
shell circumference gain (cm)	0.96 ± 0.00[a]	0.96 ± 0.00[a]	0.95 ± 0.00[a]
Initial shell Length (cm)	9.01± 0.00[a]	9.01± 0.00[a]	9.01± 0.00[a]
Final shell Length (cm)	9.06 ± 0.00[a]	9.06 ± 0.00[a]	9.01 ± 0.00[a]
Shell Length gain (cm)	0.05± 0.00[a]	0.05± 0.00[a]	0.06± 0.00[a]
Total feed Intake (g)	488.87 ± 7.26[c]	504.53± 2.24[b]	519.78± 3.15[a]
Feed Conversion Ratio	57.04± 3.45[c]	50.76± 3.25[b]	43.97± 2.33[c]

a,b,c: Means within row bearing same superscript are not significantly (P>0.05) different

The results in Table 3 presents the Reproductive characteristics of the breeder snails fed with soya bean meal at varying level of inclusion for 10 weeks. There were significant differences (P<0.05) among the different level of SBM inclusion for all the variables that were examined, (number of eggs laid, Percentage fertility and Percentage Hatchability). The snails in 27% inclusion level had the highest values of 23.67 ± 1.44, 85.53 ± 1.83 and 91.02 ± 0.39 for number of eggs laid, Percentage fertility and Percentage Hatchability respectively while snails fed 27% SBM level of inclusion had the least percentage embryo mortality of 8.93 ± 0.27 which was significantly (P<0.05) different from others fed with 23% and 25% level of inclusion with 16.98 ± 1.32 and 13.23 ± 2.14 respectively.

Table 3: Reproductive Characteristics of Breeder Snails fed Soya bean meal at varying level of inclusion 23%, 25% and 27% for10 weeks.

Parameters	Level of inclusion		
	23%	25%	27%
No. of eggs laid	19.67 ± 0.37[b]	19.78 ± 6.04[b]	23.67 ± 1.44 [a]
Percentage fertility	79.56 ± 2.83[b]	78.89 ± 2.44[b]	85.53 ± 1.83 [a]
Percentage Hatchability	83.01 ± 1.04[c]	86.77 ± 2.24[b]	91.02 ± 0.39 [a]
Percentage Embryo mortality	16.98 ± 1.32[a]	13.23 ± 2.14[b]	8.98 ± 0.27 [c]

a, b, c: means within rows bearing same superscript are not significantly (p>0.05) different.

Discussion

The significant differences among the treatment levels and the highest final body weight and body weight gain with 27% inclusion level of SBM was an indication that higher protein level of that meal enhanced the growth of the snails. This is in consonant with the observation of Ugwuowo *et al.,* (2011) that achievement in snail production incorporate among other things, protein nutrient which should be provided for faster growth. Protein sources should be added in feed for better growth and return in investment. This is in line with the findings of Ejidike (2001) and Ejidike (2007) that higher protein level of diets results in better efficiency of feed utilization and better growth performance. It also shows that compounded feed when properly formulated and

prepared is appropriate in feeding snails under captive rearing. Soya bean meal contains some essential amino acids which also enhances growth. Significant differences observed in the final shell circumference might be due to differences in the maturity age of snail because snails attain maturity in about 18 to 24 months of age as observed by (Etukudo *et al.,* 2016).

Significant differences recorded in the total feed intake and feed conversion ratio indicated that snails fed 27% levels of SBM had higher feed intake and least feed conversion ratio. This is in line with the findings of Oyeagu, (2015) that growth, development and reproduction of animals are highly dependent on the quality of feed consumed and snails in this experiment took the advantage of high protein content of the feed as snails fed 27% levels of SBM had higher feed intake and least feed conversion ratio.

The reproductive performance of the breeder snails fed soya bean meal at the different levels of inclusion showed significant differences ($P<0.05$) in all the parameters considered. Breeder snails fed with 27% level of SBM inclusion had the highest number of eggs laid, percentage fertility and percentage hatchability except in the percentage embryo mortality where the breeder snails fed with 23% SBM had the highest embryo mortality. Snails do better when higher levels of protein are included in their diet. It is likely that the nutritional quality of diet which was high in treatment three (27% SBM) level of inclusion must have affected the number of eggs laid, percentage fertility and percentage hatchability with a lesser mortality of embryo. Eniolorunda *et al.,* (2007) reported that diet with better ingredient combination were utilized more efficiently when feed to animals. Thompson *et al.,* (2004) also reported that poor nutrition affects snail growth and a drop in the reproductive performance. This is also in agreement with the findings of Okon and Ibom, (2012) that egg production, egg weight, and hatchability will increase with increase in the level of protein in the diet.

Conclusion

It was observed that SBM at 27% level of inclusion supported higher final body weight, body weight gain, total feed intake, number of eggs laid, percentage egg fertility, percentage egg hatchability, lower embryo mortality while the breeder snail fed 23% of the protein source recorded the highest mortality because of the nutrient quality of ingredients in the diet. The study also revealed no significant differences in shell circumference gain, final shell length and shell length gain as a result of the slow growth rate of snails. However, breeder snails fed 23% of soya bean meal had the highest feed conversion ratio as a lower feed conversion ratio is a good indication of a higher quality feed.

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